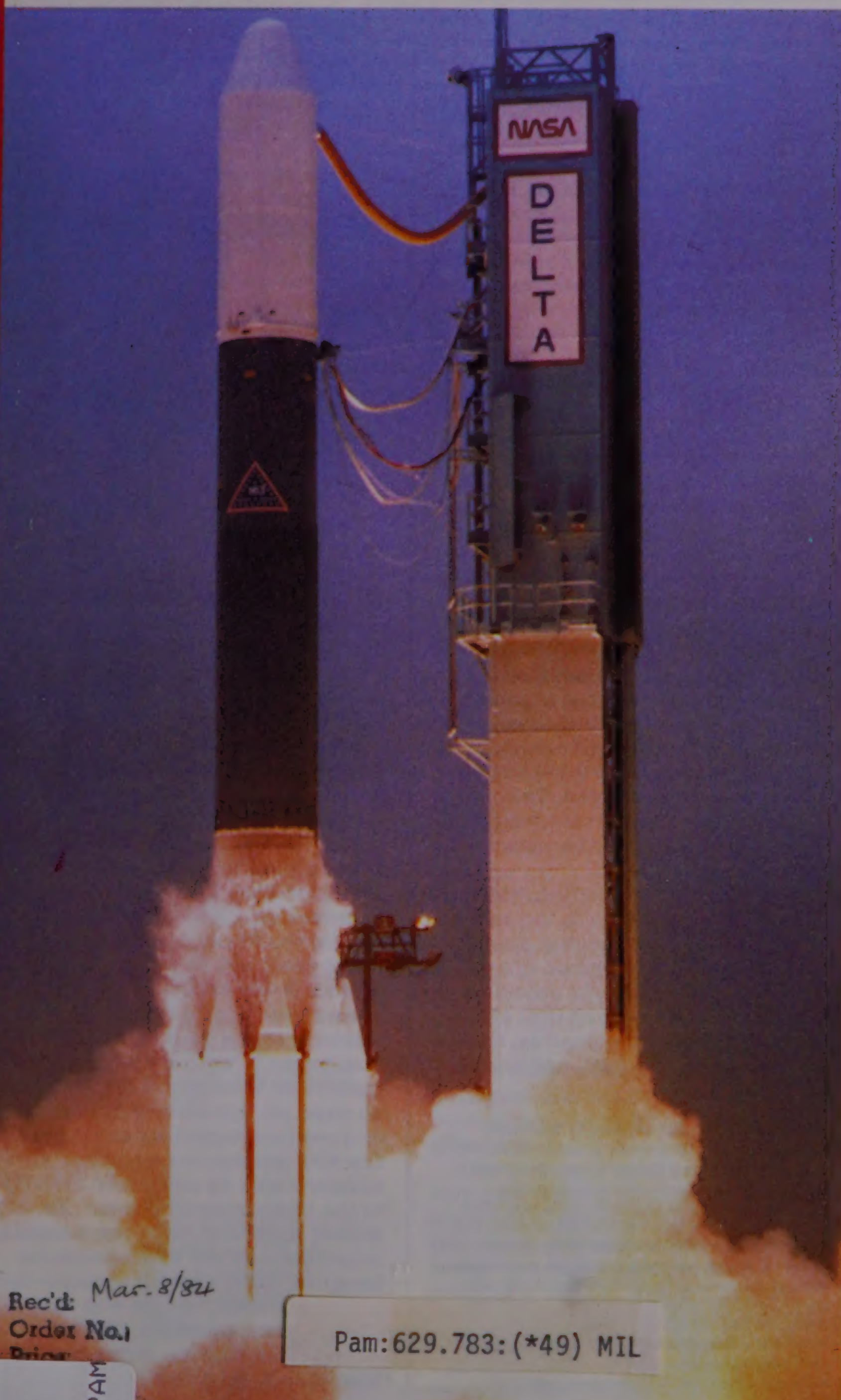
Landsat DATA USERS NOTES

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NOAA U.S. DEPARTMENT OF COMMERCE

ISSUE NO. 30 MARCH 1984



MARCH 1 LAUNCH: LANDSAT 5

On March 1, 1984, between 9:59 p.m. and 6:05 p.m., Pacific Standard Time (PST), Landsat D' will be launched from Vandenburg Air Force Base near Lompoc, California. Designated Landsat D' until after launch, when it will be known as Landsat 5, this vehicle is the backup satellite for Landsat 4.

A special telephone "hotline" has been set up in Greenbelt, Maryland, to play recordings of NASA status reports on the satellite during its first several weeks in orbit. The number is **(301) 344-0470.**

After Landsat 5 is positioned over the proper Worldwide Reference System (WRS) ground track, NOAA intends to use it for routine data collection over the United States. Landsat 4 will be used for special acquisitions.

Non-U.S. ground stations will have access to both satellites within system operational and power constraints.

RFP RELEASED: ADVISORY COMMITTEE SUBMITS RECOMMENDATIONS

The Civil Operational Remote Sensing Satellite Advisory Committee (CORSSAC), also known as the "Halbouty Committee," met in Washington, D.C., January 26-27, 1984, to review the Department of Commerce's Request for Proposals (RFP) for commercializing the Landsat system.

The RFP was released on January 3, 1984. Bids were originally scheduled to be received by February 29, 1984, but the due date has been extended to 12:00 noon, Eastern Standard Time, March 19, 1984, to provide additional time for preparation of responses. Selection of a successful bidder is expected by June 1984.

CORSSAC draws its membership from the former Land Remote Sensing Advisory Committee. Its charter is to advise the Secretary of Commerce on matters pertinent to the Department's responsibilities regard-

LANDSAT D' EVENT ACTIVATION TIMELINE

	First Minute (in seconds)	First Hour (in minutes)	Flight Day Th 1	F 2	S 3	Su 4	M 5	T 6	W 7	Th 8	F 9	S 10	Su 11	M 12	T 13	
1. Launch & Separation																
Stage I-liftoff	0.0															
Initiate Guidance	20.0															
Main Engine Cutoff		3.76														
Stage I - Stage II Separation		3.90														
Stage II Ignition		3.98														
Stage II Cutoff		54.37														
Landsat 5 Separation		59.26														
2. Solar Array Development and Rotation			■													
3. Altitude Control Activation			■	■	■											
4. Command and Data Handling Activation			■													
5. Wideband/Sensor Activation																
X-band/MSS (1-4) (night)						■										
X-band/TM (1-4)							■									
X-band/TM (1-4), MSS (1-4), S-band/MSS (1-4)								■								
TDRS Preparation and Testing										■	■	■	■	■	■	
TM (5-7) outgassing															■	
TM (5-7) door open																→ DAY 35
X-band (1-7)																→ DAY 37
6. Global Positioning System											■					
7. High Gain Antenna-Boom Deployment								■								
8. Orbit Adjust																
Synchronized to WRS																→ DAY 33
Begin Acquisition Cycle 1																→ DAY 35

ing civil operational weather, land, and future ocean remote sensing from space, including commercialization issues. The Committee's membership is expanded over its previous number and now includes individuals with expertise on oceans and atmosphere.

CORSSAC's review of the RFP concerning transfer of the U.S. land remote sensing program to the private sector resulted in the following recommendations, which were forwarded to the Secretary of Commerce the last week in January:

"If the best interests of our citizens are to be served, the Committee believes, without reservation, that the United States Government must commit itself to the continuity of a Governmental or private sector civil land remote sensing system. This conviction stems not only from the role remote sensing technology plays in enhancing the economic base of the country, but also from the pervasive influence such information will have on improving the future quality of life on earth.

"RECOMMENDATIONS:

"1. In light of the non-Federal user requirements for global data of higher spectral and spatial resolution than the MSS, because no U.S. commercial satellite system will succeed unless it provides data commercially competitive in the world marketplace, and in view of the fact that high resolution data can be resampled to meet MSS user requirements, the Government must ensure that there is no interruption in acquisition, distribution, and archiving of, at a minimum, 'TM-like'* data. In this regard, whether commercialization is achieved or not, it is vital to the national interest that 'TM-like' data be continuously acquired until better systems are developed. This should be an important factor in your evaluation of the responses to the RFP.

"2. It is vital for the United States to remain competitive in the international remote sensing marketplace and to investigate critical global environmental problems. Therefore, we believe that the Government must provide, or cause to be provided, aggressive, long-term, exploratory research and development in civil land remote sensing.

"3. It is imperative that the United States continue its policy of timely and non-discriminatory data access at equitable prices.

"4. The Government must provide, or cause to be provided, a national archive of all previously acquired and future acquired land satellite data so long-term changes in global environments can be evaluated by present and future generations."

The Committee may convene again when a decision is reached on a successful bidder. This time the members would consider and/or review the Government's transition plans pertinent to accomplishing a private sector transfer.

Any user with questions or comments to share with the Advisory Committee is welcome to contact its individual members (see the listing on page 14). Alternatively, comments or questions regarding any aspect of the RFP process or transition period to follow may be addressed directly to the Committee Chairman, Dr. Michel Halbouty, or to the Assistant Administrator for Environmental Satellite, Data, and Information Services, National Oceanic and Atmospheric Administration (NOAA) Federal Building No. 4 (Room 2069) Mail Stop E, Suitland, MD 20233.

* 'TM-like' data: data currently acquired synoptically over swaths greater than 100 km; data acquired in a sun-synchronous manner with illumination conditions similar to those of Landsat; data acquired with 3 bands in the visible, 3 bands in the reflected infrared, and one band in the thermal infrared; data acquired at a resolution of 30 meters in all but the thermal band and 120 meters in the thermal band; data having bandpasses, radiometric sensitivity, geometric fidelity, etc., within a few percent of the characters of the present thematic mapper (TM) sensor system.

SCENE ID DISCREPANCY

was discovered recently that the
natic mapper (TM) Image Process-
System (TIPS) at NASA/Goddard
incorrectly computing the
ecraft time information that is
ed in the time-of-acquisition field
ery TM scene ID. Spacecraft
of data acquisition should
ct the time at which the image
line passing through the
dwide Reference System (WRS)
e center is sensed. However, un-
ecently, this information was be-
omputed based on when the
scan line in the image was ac-
ed.

is was causing a discrepancy of
er 1 or 2 in the ten's-of-seconds
in every TM scene ID recorded
ugh December 27, 1983. Tens of
nds are the smallest unit of
sure used to record time of ac-
ition in a Landsat scene ID;
efore, the discrepancy consists of
ore than 10 or 20 seconds. The
is consistent wherever the TM
e ID is given, on both film and
al products.

e problem was corrected by
A in late December. Any TM ar-
al high-density tape products
uced on December 28, 1983, or
have the scene ID time of ac-
ition computed correctly, that is,
d on spacecraft time over the
scene **center.**

ease note that even with this
ection Landsat 4 TM scene ID's
still ocassionally disagree with
coresponding Landsat 4 MSS
e ID's, as the framing algorithms
not identical.

NE ID FORMAT:
MAGERY

DDD-HHMMS-X

re:
Project (Landsat)
Mission (Landsats 1, 2, 3, or 4)
Day since launch
Hour of acquisition
Minute of acquisition
Second (in ten's) of acquisition
Band designator

nple:
40504-14554-1

This digit may be incorrect on TM imagery processed before December 28, 1983.

APPLICATIONS OF REAL-TIME LANDSAT IMAGES IN ALASKA

by
John M. Miller
Senior Applications Engineer
Geophysical Institute
University of Alaska

Alaska is a huge land with many dynamic geophysical processes occurring in remote locations, which restricts the monitoring of changes by conventional means of observation. Volcanic eruptions, ice jams, navigation hazards, and forest fires are examples of unpredictable but important events with economic or scientific implications.

When an event is short-lived or rapidly changing, it is necessary to obtain surveillance data in near real time if the potential benefits of the observations are to be realized. In the early days of the Landsat program in Alaska, it became very evident that a large domain of new applications existed for such data if products could be placed in the users' hands within a few hours of a satellite pass.

With the cooperation of NASA, and now NOAA, the University of Alaska's Geophysical Institute has studied the concept of generating high-quality images directly from MSS data that were downlinked from the satellite in real time to the existing ground station in Fairbanks. State funds were used to develop stand-alone data storage and image generation equipment which could utilize these raw MSS data.

Although it is called a "Quick-Look" system for obvious reasons, no degradation in quality is required in order to achieve the rapid response. The system preserves the full resolution of detail that is inherent to MSS data under other processing scenarios. Another trait of the system is its flexibility to tailor products to the exact requirements of various applications. The capability exists, for example, to perform digital enhancements and/or enlargements (up to 8X) on either color-composite or black-and-white products.

The system is designed for selective data acquisition, not broad coverage of the entire surface. During a pass, the real-time data from one of the four bands is displayed, without correction, on a moving-window display for operator evaluation and subsequent scene selection. The system can acquire up to 20 complete MSS scenes at a time (in four bands) and store them on disk for later image generation. No digital archiving of data is provided; acquired scene data are written over the fresh data after the desired images have been converted to film.

Standard processing for generating an image includes corrections for film gamma, sensor balance, system geometry, and selectable contrast stretching. Enlargements of subscenes are possible in increments of two, four, or eight times original size. Monochrome images are generated on a laser film recorder; color Polaroid composite prints are produced on a color graphics camera. High quality color-composite film for special applications can be produced from a set of single-band black-and-white negatives in a photo lab, and requires an extra day or two.

Custom-enhanced image products generally can be delivered to a user anywhere in the State of Alaska on a same-day basis using air courier services. Some examples of the applications that have been served by these quick-look image products are described below.

NAVIGATION HAZARDS

The University of Alaska's Landsat quick-look program documented the activities of Soviet icebreakers that were assisting a number of Russian ships caught in early ice last fall. The region of the subscene shown in Figure 1 is located about 300 miles west of Point Hope, Alaska, 125 miles south-southeast of Wrangell Island, and about 50 miles east of the Siberian settlement of Cape Schimdt.

The spacecraft passed over the region under reasonably clear skies shortly after the Soviet news agency, Tass, first reported arctic shipping difficulties of great magnitude. Referring to Figure 1, it is apparent the icebreakers have broken two loops (lower left) in the new (shorefast) ice after carving a slanting trail from the more open pack ice near the upper right edge of the image. The loops were probably made to encompass one or more ships stuck in the ice in that region.

Another trail extends northward to a much smaller loop, marking another presumed rescue attempt, before exiting the continuous ice pack into the broken, large floes of the multi-year ice of the Chukchi Sea.

Also noteworthy is the major fracture, and the network of smaller leads, that developed in the shorefast ice in the general region of the

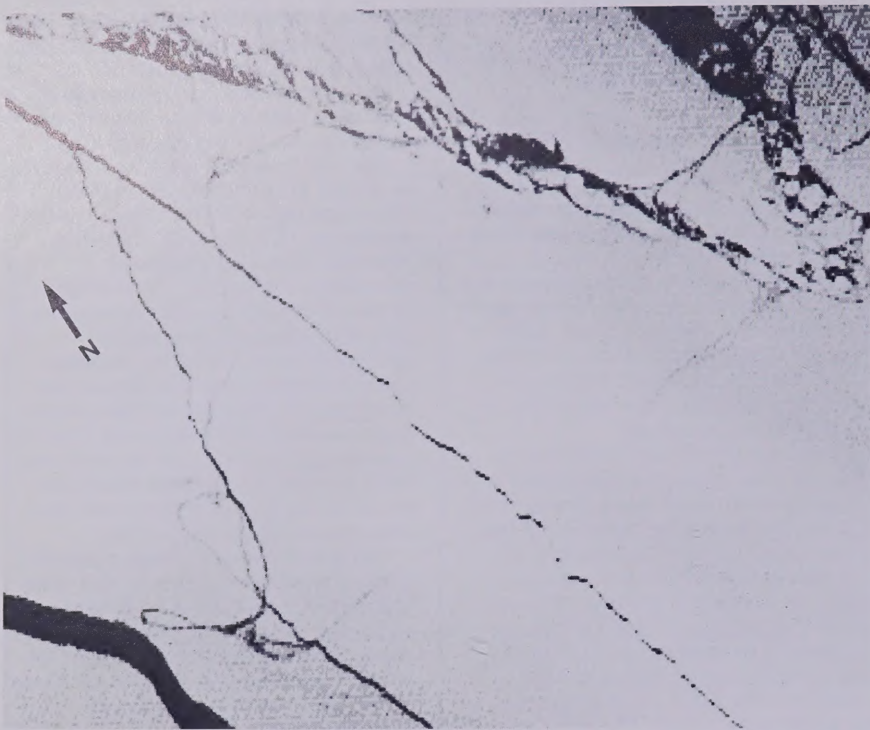


FIGURE 1. This quick-look Landsat 4 image clearly shows trails of Soviet icebreakers conducting rescue operations on behalf of ships caught in the fall ice of the Chukchi Sea offshore of eastern Siberia. Data were acquired on October 24, 1983.

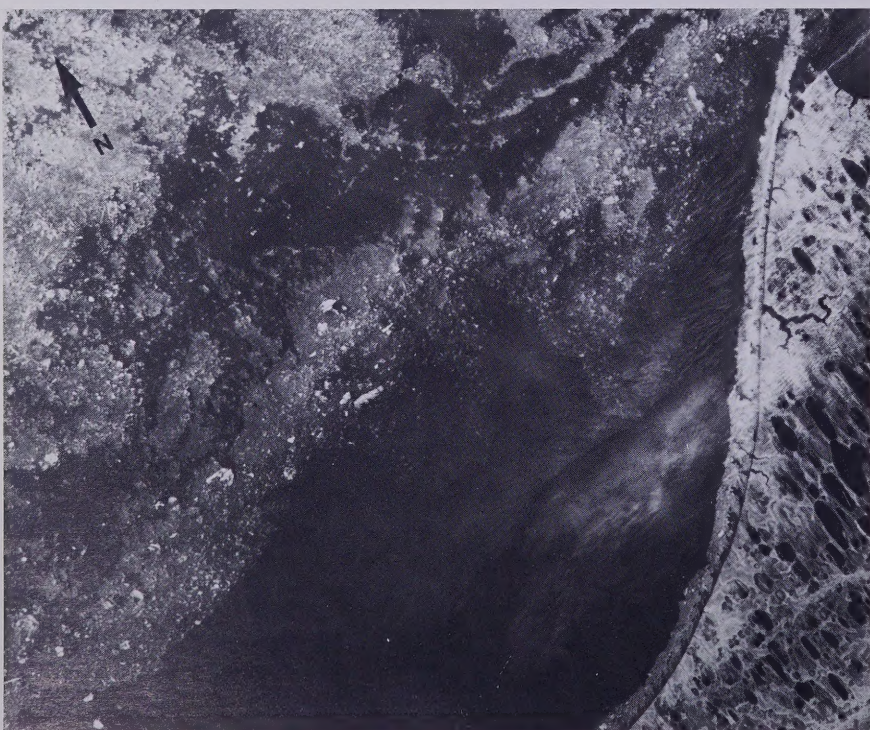


FIGURE 2. Marine traffic to Prudhoe Bay and the North Slope of Alaska must pass around Point Barrow during a few ice-free weeks (or days) in August. Here an August 5, 1982, image shows a ridge of grounded ice extending along the shoreline and northward about 8 miles into the pack ice, thus creating a barrier to vessels.

rescue operations. The shore-fast i was wind-stressed, causing the ma leads to open and the tightly pack multi-year ice to break up somewh University sea ice specialists speculate that the multi-year ice may have been transported to this region unusually early by exceptionally persistent wind patterns.

Marine transport in ice-suscepti waters could be less risky with an international ice-surveillance syst covering the whole of the artic bas Such a system, with high-resolutic capabilities and real-time imaging output, could have given advance warning that early arrival of mult year ice in the shipping lanes was likely.

The communities and oil fields along Alaska's North Slope also depend upon yearly resupply mission to receive durable goods. Each summer a fleet of barges must find its way around the west coast of Alask and past Point Barrow. The timing the transit past Point Barrow is critically dependent upon the retre of sea ice, which typically can last from only days to a few weeks in August.

Normally the barge mission anchors along the northwest coast of Alaska to wait for favorable ice conditions. The waiting is costly, and the timing of both entering and lea ing the Beaufort Sea east of Point Barrow is critical. Custom-enhance Landsat prints can be delivered to barge-company offices in Barrow or Prudhoe Bay within 6 hours of a satellite pass to aid in the decision to when to make the dash along the north coast of Alaska.

Figure 2 is a one-quarter scene, MSS band 4 (near-IR) image acquire August 5, 1982, showing the northwest coast of Alaska and Point Barrow, which is located at the tip of t penisula in the extreme upper righ The left half of the image shows broken pack ice and thin clouds. Along the coast itself is a half-mile-wide ridge of ice that is grounded. The grounded ice extends about 8 miles northward from Point Barrow and into the pack ice. This ridge formed a barrier to shipping and wa of critical concern to the barge company, because other conditions eastward from Barrow were favorable at this time. This routine ice-surveillance using Landsat data provided an effective look at ice details of relatively small dimensions to aid the assessment of marginal navigation conditions.

The skipping pattern of the Land

overflights, coupled with the ased sidelap of sensor coverage r north latitudes, keeps the ay repeat cycle from being a e limitation to the benfits of time Landsat data. Coverage Point Barrow to Prudhoe Bay is ided by nine adjacent ground s (or paths) of Landsat, and it is ble to get coverage from one within this region at least y other day.

EST FIRES

gure 3 shows a Landsat image of ctive forest fire 70 miles north- of Fort Yukon, Alaska, near dik Lake, the large, bootprint- ed black feature left of center. k-look images generally are ered to fire-suppression agencies in 3 to 4 hours of the overpass. are used to aid in assessment of urce values, fire-fuel ratios, and r terrain constraints that in- nce decisions affecting how best ppress a fire. During the course tive suppression activities, sat images also are used to the effectiveness of fire- ting techniques such as blishing fire breaks and back- ing.

e fire shown here burned 000 acres over a 90-day period. en images were acquired during -month phase of active suppres- efforts, starting with the exact of ignition from a lightning n.

SS band 4 (near-IR) imagery is useful for fire surveillance use it penetrates thin haze and e better than the visual bands. infrared band also is very sen- e to the degree of charring of t canopy and understory vegeta- . It can be used to delineate re the fire burned deeply into moss, contrasted with areas re the fire spread only through forest canopies.

an indicator of vegatative r, the near-IR band also reveals erns of old burns in the pre-fire in. The lighter tones in the non- ed areas that surround parts of blackened area of the current usually are indicative of kets or brush regenerating from arlier fire. Within the current ed area, the blackest tones show re the fire has penetrated est into the vegetative mat on ground. The lighter tones within current burn reflect where the was largely confined to the up- tory.

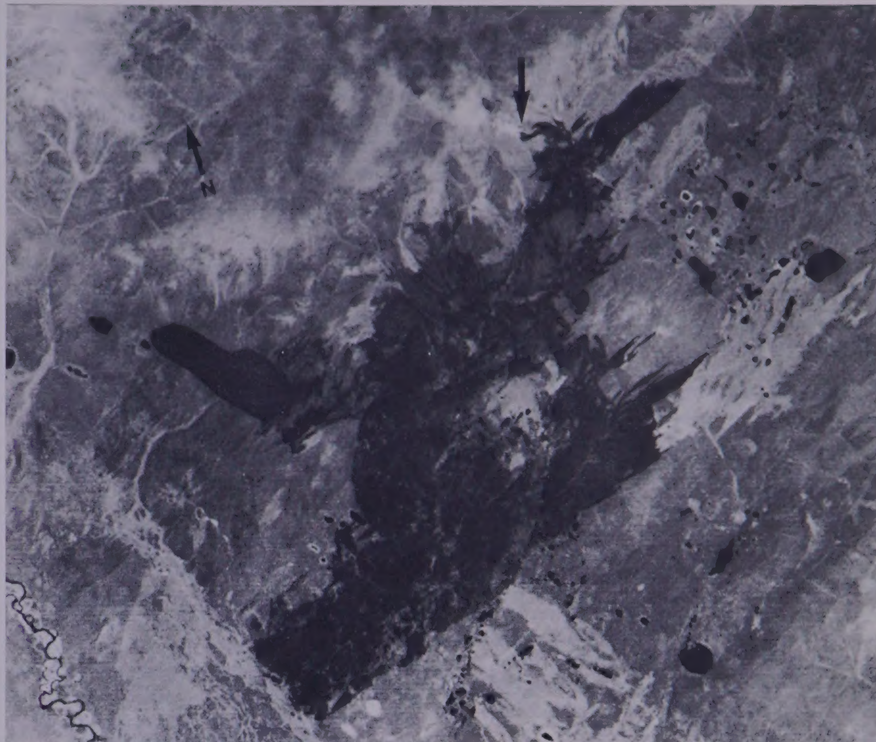


FIGURE 3. MSS band 4 (near-IR) is effective in surveillance of wildfires because it penetrates haze and smoke well and delineates intensity and extent of vegetative charring. This is a 200,000-acre fire near Vundik Lake, 70 miles northeast of Fort Yukon, Alaska.

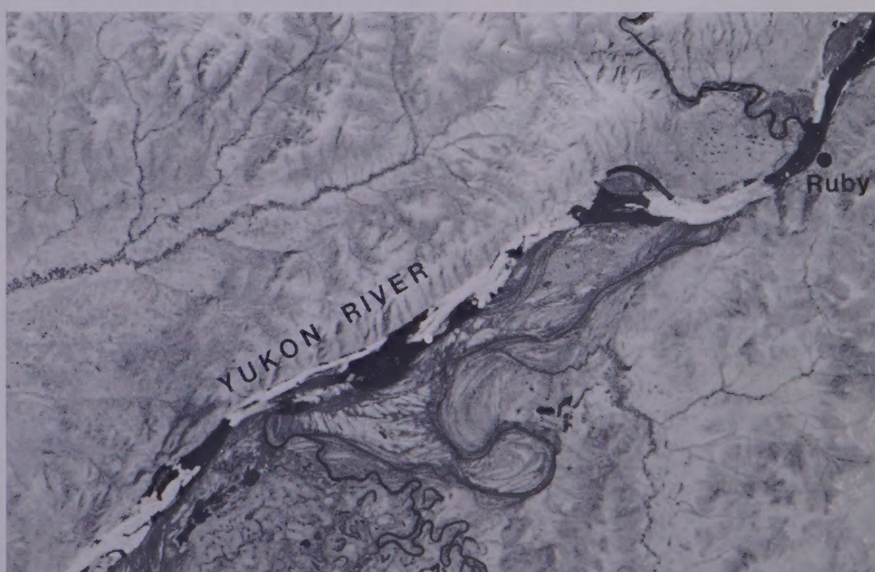


FIGURE 4. Real-time surveillance of river breakup enhances forecasts of ice jams and floods. Residual ice is shown here in the Yukon River near the village of Ruby on a May 10, 1983, quick-look image.

Lakes throughout the scene show up totally black with smooth boundaries. It is noteworthy that a fire seldom burns deeply into the ground mat immediately adjacent to a lake, owing in part to the mat of vegetation being saturated with moisture. One lake of moderate size near the center is surrounded by the current burn, but its perimeter is narrowly banded by cover that was only lightly burned.

A thin column of white smoke (see arrow) can be discerned at the top of the burn and is the one active hotspot on the day of this image. The smoke column appears to lack contrast, but this is quite deceiving owing to near-IR wavelengths being relatively insensitive to smoke. The smoke column actually marked a major flare-up of the fire, which later spread from this protrusion over the next few weeks. The smoke was in fact very dense when viewed in the visible bands. Color composite images constructed from bands 1, 2, and 4 are used when the user needs information pertaining both to the areal extent of the charring and to the location of the currently active fronts as marked by smoke columns.

FLOOD SURVEILLANCE

The breakup in spring of major rivers in Alaska is an important event for two reasons. One is that the open water marks the start of a new season of transportation and fishing for the remote villages. The other is that ice jams can occur at this time of year, causing flooding and serious loss of property in the rural areas.

The Yukon River is well suited to repetitive Landsat coverage because it extends 800 miles in an east-west direction. Consequently, it is exposed to potential Landsat coverage at two places daily. It also has a southwestward trend starting at Koyukuk which extends for 200 miles parallel to a Landsat ground track. At this part of the river it is possible to obtain four adjacent rows (scenes) from each of three adjacent satellite paths. Such favorable geometry helps to increase the likelihood for acquiring some useful data every day in spite of the vagaries of cloud cover.

Figure 4 is a May 10, 1983, subscene showing remnant ice downstream from the village of Ruby. Spring breakup of the rivers can create a flood hazard to communities upstream from ice jams such as these, which tend to occur in the bottlenecks of river channels. Routine surveillance by Landsat can aid in monitoring ice conditions and may enhance forecasts of potential flooding. During the period of river breakup, same-day Landsat images can be delivered to the River Forecast Center in Anchorage to aid forecasting of flood watches and warnings.

The coverage area of the Alaska ground receiving station extends through an 1800-mile radius (approximately) of Fairbanks. Users who might benefit from rapid access to Landsat images of Alaska and vicinity should contact the Geophysical Institute, University of Alaska, 903 Koyukuk Ave., Fairbanks, AK 99701. Telephone: (907) 474-7363.

13th LGSOWG MEETING HELD IN WASHINGTON, D.C.

The 13th meeting of the Landsat Ground Station Operations Working Group (LGSOWG) was held November 14-16, 1983, in Washington, D.C. This was the first meeting chaired by NOAA since assuming management responsibility for the Landsat system from NASA on January, 31, 1983.

Dr. John H. McElroy, Assistant Administrator for Environmental Satellite, Data, and Information Service, led the meeting.

In attendance were representatives from Argentina, Australia, Brazil, Canada, the European Space Agency (ESA), India, Italy, Japan, the People's Republic of China, South Africa, Sweden, Thailand, and the United States (the latter including representatives from NOAA, NASA, the U.S. Geological Survey, and the Department of State).

Topics of discussion included a report on the status of Landsat 4 and Landsat D' launch preparations, an update on the commercialization of the U.S. land remote sensing satellite program, a presentation on TM early results, and a summary of worldwide Landsat data sales. The following is a summary of each country's report on the status of its remote sensing programs.

Argentina: The Argentine station has not been receiving data since Landsat 3 was shut down in March 1983. The station is currently being upgraded for Landsat 4 MSS data reception. The Argentine representative noted that modifications are expected to be completed in early 1984, and that the government is considering plans to upgrade the Argentine facilities for TM and SP(reception, as well.

Australia: The Australain stati has been receiving Landsat 4 MSS data since December 1982, and beg providing data on an operational basis in June 1983. In February 1983, a legislative initiative for funding of an upgrade that would permit reception of TM data was withdrawn after the newly elected government in Australia took offic New submissions are being prepare for the FY 1984-85 budget, which has a good chance of being ratified. In addition, responsibility for the Landsat station is being transferre to the Department of Resources an Energy.

Geology and cartography remain the major applications being pursu in Australia, while private industr continues to be the largest user of data. In May 1984, the Landsat-84 conference, a major remote sensing symposium, will be held in Australia. Recently, a Master's degree program in remote sensing was established at the University c South Wales.

Brazil: The Brazillian representative reported that a new receivin system with X-band and S-band capabilities had been completed in August 1982 and is operational. Th station is now ready to receive TM data when available. Acceptance tests for the TM processing system were to begin on November 20, 198 and, assuming no major problems, the system was to be installed by t end of the year.

Landsat data have been used for numerous applications in Brazil. They include, for example: monitor ing deforestation in the Amazon; surveying national sugar cane production; monitoring disasters such as frost, drought and oil spills; developing methodologies to discov clay, copper, zinc, and oil deposits; and mapping underground water reserves. The Brazilian remote sens ing agency is also studying the development of a geocoded data bas

A new national remote sensing program in Brazil was developed ov the past year. Money has been allocated to establish five regional training and data analysis centers and provide grants to universities for research. Plans have been approved to build two remote sensing satellites for launch in the early 1990's on a Brazilian launch vehicl These spacecraft will be in a near-polar orbit and carry a 4-channel, 50-meter resolution charge-coupled